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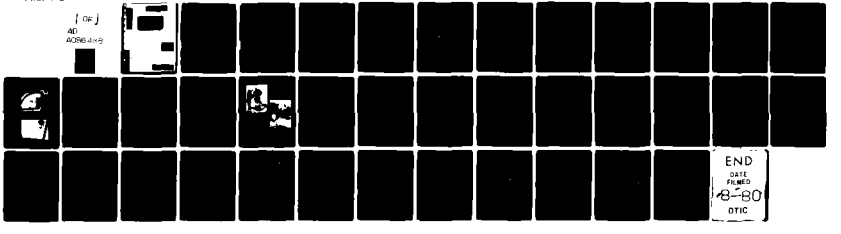

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DIVING DECOMPRESSION COMPUTER (XDC-2)
VALIDATION DIVES, 36 - 54 msw.
PHASE I - PRELIMINARY RESULTS.

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DEPARTMENT OF NATIONAL DEFENCE - CANADA

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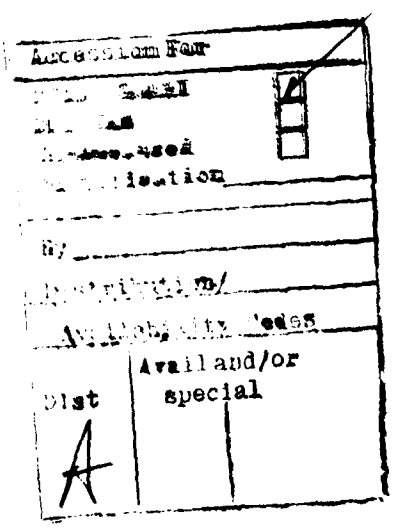

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"DIVING DECOMPRESSION COMPUTER (XDC-2) VALIDATION DIVES, 36 - 54 msw PHASE I - PRELIMINARY RESULTS

ABSTRACT

The Canadian Forces have used decompression computers for a number of years. However, advances in electronics have allowed the older analogue computers (Mk VI) to be replaced by more sophisticated digital electronic computers (XDC-2's) which monitor the diver's depth and calculate the safe depth in real time.

An operation lasting four weeks[1] was conducted at DCIEM utilizing the newly acquired Deep Diving Facility as the vehicle to test the operational diving envelope of the XDC-2 Decompression Computer at 36-54 msw. Ultrasonic Doppler monitoring techniques were used throughout the series of dives to measure bubble activity in the pulmonary artery.[2,3]

The initial results would seem to elucidate the XDC-2 computer envelope by adding more information and more clearly defining the present calculated operational curves. As it was necessary to find a new reference point between the calculated curves, The Royal Navy Limiting Line as published in the R.N. Diving Manual (BR 2806) Table Eleven, was introduced as a datum line. It was found that there was a degree of correlation between the R.N. Limiting Line and that of the XDC-2 recalculated operational envelopes. Doppler ultrasonic monitoring results confirmed the severity of a dive and it was possible to grade a dive profile as mild, moderate or severe.

INTRODUCTION AND AIM

A series of air dives were carried out in the Deep Diving Facility (19 Jun 79 - 13 Jul 79 to determine the safe operational envelope of the XDC-2 Decompression Computer to a maximum simulated depth of 54 metres of sea water.

The predicted envelope is shown in Figure 1. and was reproduced as a result of a large number of chamber dives over the past ten years using versions of the Kidd-Stubbs decompression model for decompression control.([4])

The following graph depicts the predicted diving envelope. The various boxes depict the number of decompression incidences within that area. The outer curve (solid) was calculated to show a 10% bends incidence, and the middle curve (broken) a 3% bends incidence, while the inner curve (broken) shows nil decompression.

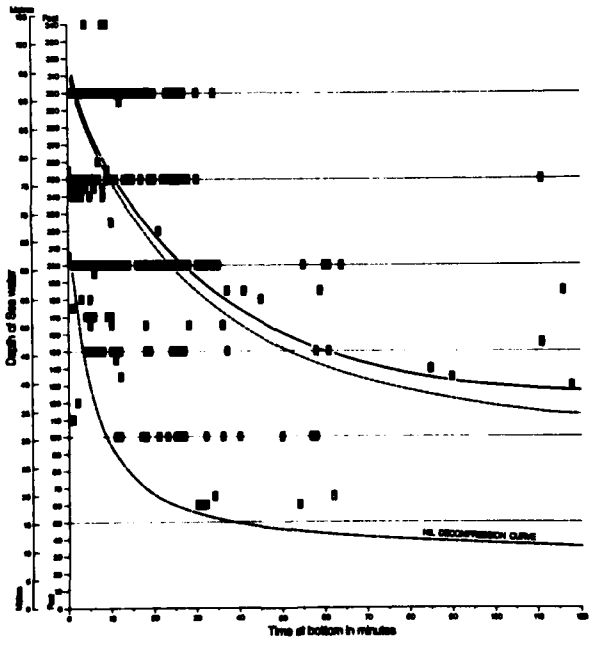


Fig. 1 XDC-2 (Predicted) Operational Envelope

BACKGROUND

The DCIEM Decompression Computer([4],[5]) is used for the safe decompression of divers by monitoring the actual depth-time history of a dive and calculating and displaying the safe depth for optimum decompression. In the past, the computer was used successfully in the form of a pneumatic analogue computer. With recent developments in electronics, it has become possible to replace such analogue computers with miniature digital electronic computers which monitor the diver's depth and calculate the safe depth in real-time.

The XDC-2 Digital Decompression Monitor was designed for DCIEM on contract by CTF Systems Incorporated.([6]) The advantage of a digital computer such as the XDC-2 is that it requires a minimum of calibration and maintenance. Because the safe depth is calculated mathematically and is presented on the digital display, it is possible to follow the safe depth exactly during decompression.

The objective of the present series of dives([1]) was to evaluate the XDC-2 for operational diving, to determine whether the safe depth as displayed can be followed exactly for safe decompression, and to define the operational limits for its use. The basic dive profile was descent at a rate of 18 metres of seawater (msw) per minute to depth, and remaining at that depth for the required time; initial ascent was at 18 msw/min to the calculated safe depth, continuous ascent following the safe depth to 3 msw, a stop at 3 msw until the computer indicated that surfacing was possible, and then ascent to the surface.(See Figures 2, 3).

The DCIEM decompression calculation model has been determined by carrying out a large number of man-dives. The model itself consists of four compartments in series with the same depth-dependent supersaturation ratio applied to all compartments. Under certain conditions, for deep dives or long bottom times, the model gives decompression profiles which become inordinately long at the shallow depths when the third and fourth compartments become the controlling compartments for decompression.([7]) The maximum bottom times, which are intended to define the operational limits for the present dive series, have been selected so that the third and fourth compartments are not controlling the decompression. Several bottom times leading toward the maximum bottom time were tested for each depth.

In order to assist in the evaluation of the dive profiles as generated by the XDC-2 and to determine their relative safety or to determine whether any modifications need to be made in the future, the divers were monitored for bubbles in the pulmonary artery with the Doppler Ultrasonic Bubble Detector. Dry divers were monitored periodically during the decompression phase in the chamber. On the surface after decompression, both dry and wet divers were monitored periodically during the decompression phase in the chamber. On the surface after decompression, both dry and wet divers were monitored periodically for several hours.

JUNE, 1979

	M	T	W	T	F	M	T	W	T	F
CALENDAR DATE	18	19	20	21	22	25	26	27	28	29
DIVE DAY		1	2	3	4	5	6	7	8	9
DIVING PERSONNEL										
R								C		
K				A						
M						C				A
O			B		C		D		E	
F								E		
LA		C				A				E
MA				C				A		
J.			S		S		S		S	
R		A				E				C
N										
MA		F		B						S
PA						S		S		F
MAT			C		F		E		B	
L			D		E		F		A	
F			E		B		A		D	
S.			F		A		B		C	
G										
LE			A		D		C		F	
C		S				B				
PC		B				D		F		
E				S		F				
SU				E						D
KE		E		D						
SK										
NO		D						B		
ME				F				D		B
CR										
	B Team	A Team	B Team	A Team	B Team	A Team	B Team	A Team	B Team	

DIVING SUBJECTS SCHEDULE

Dive Position Legend

A - Wet Diver #1

B - Wet Diver #2

C - Attendant #1

D - Attendant #2

E - Dry Subject #1

F - Dry Subject #2

S - Spare Subject

TABLE I

Diver, Diver Position and Date of Dive

JULY, 1979

	T	W	T	F	M	T	W	T	F
CALENDAR DATE	3	4	5	6	9	10	11	12	13
DIVE DAY	10	11	12	13	14	15	16	17	18
Diving Personnel									
R		A							
K				C				D	
MI						E			
O	F		A		B		C		D
FU		D		S					
LA						B			
MAN		C				F			
J	S		S		S		S		S
RE				B				E	
N									
MAC		E		A					
PA						S		A	
MAT	A		D		C		F		E
LE	B		C		D		E		F
FO	C		F		E		B		A
SAB	D		E		F		A		B
G									
LES	E		B		A		D		C
CL		F				C		S	
PO									
EA		S		D					
SU				F					
KE						A		F	
SK									
NO				E				C	
MED		B							
CR						D		B	
	A Team	B Team	A Team	B Team	A Team	B Team	A Team	B Team	A Team

DIVING SUBJECT SCHEDULE

Dive Position Legend

A - Wet Diver #1
B - Wet Diver #2
C - Attendant #1
D - Attendant #2
E - Dry Subject #1
F - Dry Subject #2
S - Spare Subject

TABLE I (Continued)

TEAM CONCEPT

There were basically two teams of Subjects, A and B Team. "A" Team consisted of four divers from the Fleet Diving Unit (Pacific) and two CEDD members. They remained as a team throughout the exercise and dived every other dive day. "B" Team dived on alternate days but did not maintain its integrity as a team; its composition varied and was dependent upon the availability of potential subjects. "A" Team was made up of military clearance divers only. "B" Team was made up of military clearance divers, ships divers and civilian ships divers.

Basically, "A" Team was controlled inasmuch as the same personnel were used throughout the exercise, although they did rotate positions for each dive. "B" Team changed its composition for each dive and therefore more variables were introduced.

EXECUTION

The dive schedule is shown in Table II.

DIVE SCHEDULE

TABLE II

DATE	DIVE DAY	SERIAL	
18 Jun	Preparation Day		
19 Jun	1	A	(36 msw for 50 min)
20 Jun	2	B	(36 msw for 55 min)
21 Jun	3	B	(36 msw for 55 min)
22 Jun	4	C	(36 msw for 60 min)
25 Jun	5	C	(36 msw for 60 min)
26 Jun	6	D	(45 msw for 35 min)
27 Jun	7	D	(45 msw for 35 min)
28 Jun	8	E	(45 msw for 40 min)
29 Jun	9	E	(45 msw for 40 min)
3 Jul	10	F	(45 msw for 45 min)
4 Jul	11	F	(45 msw for 45 min)
5 Jul	12	G	(54 msw for 25 min)
6 Jul	13	G	(54 msw for 25 min)
9 Jul	14	H	(54 msw for 30 min)
10 Jul	15	H	(54 msw for 30 min)
11 Jul	16	J	(54 msw for 35 min)
12 Jul	17	J	(54 msw for 35 min)
13 Jul	18	A	(36 msw for 50 min)

Table III depicts the Dive Serial letter as described in Table I. and was used in conjunction with Annexes of the Protocol as published for this particular exercise.([1])

TABLE III
DIVE TIMES FOR XDC-2 COMPUTER

DIVE SERIAL	DEPTH (msw)	BOTTOM TIME (min)	ASCENT TIME TO 3 msw (min)	STOP TIME AT 3 msw (min)	TOTAL ASCENT TIME (min)	TOTAL TIME OF DIVE (min)
A	36	50	22	31	55	105
B	36	55	24	37	63	118
C	36	60	26	43	71	131
D	45	35	26	29	57	92
E	45	40	29	37	68	108
F	45	45	32	45	79	124
G	54	25	27	24	53	78
H	54	30	31	35	68	98
J	54	35	37	45	84	119

Descent time to bottom is included in the bottom time. Descent rate varies from 18 msw/min to 8.8 msw/min at 54 msw for the dive chamber and transfer sphere combination. Descent time to 36 msw is 2.5 min.; to 45 msw is 3.3 min.; to 54 msw is 4.2 min. The profiles were generated on the above times.

The times and depth were a calculation of Figure 1. and the intention was to stay on the cautious side of the 3% decompression sickness line.

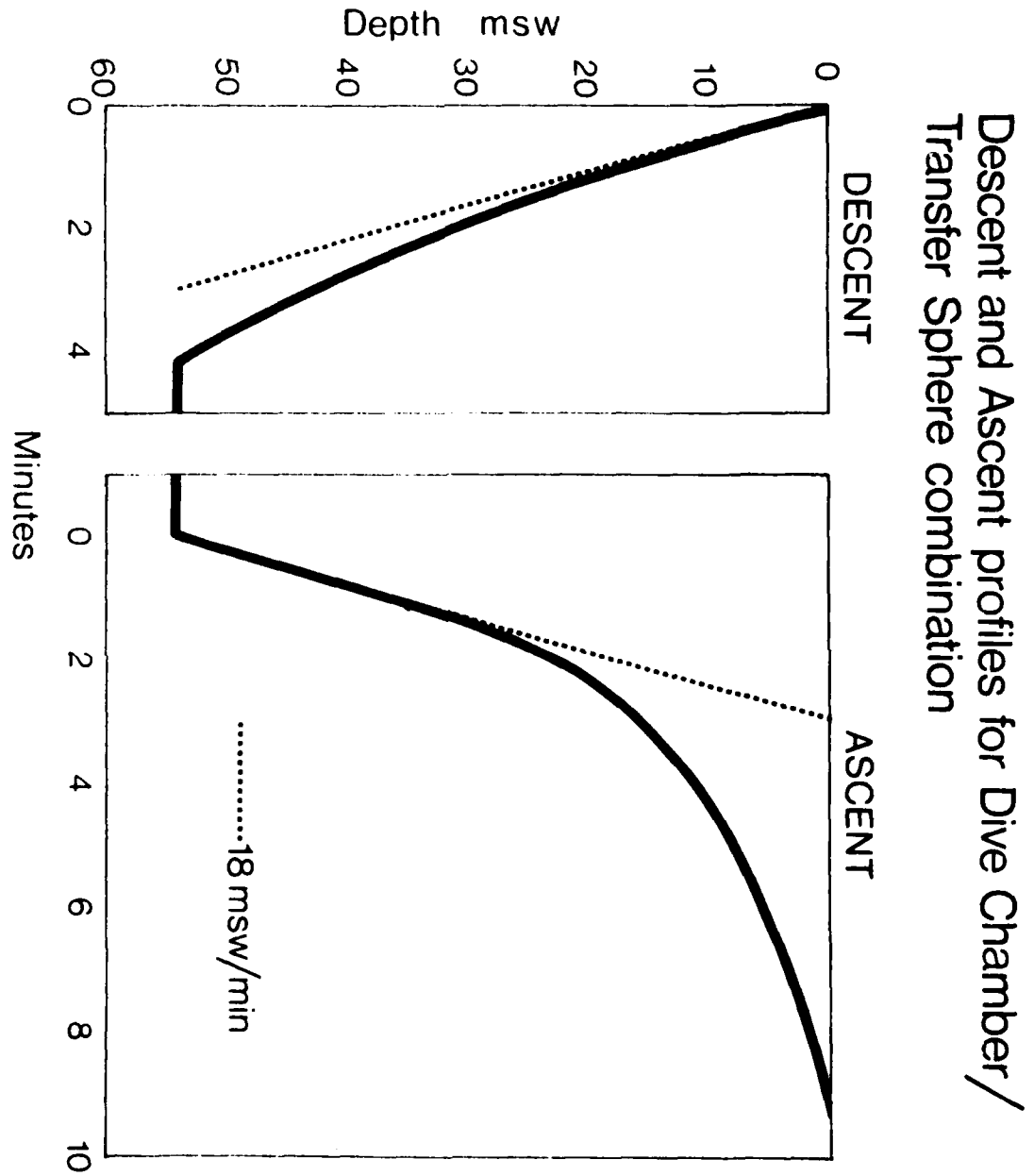


Figure 2. Descent and Ascent Profiles

Figure 3. Divers in Wet Chamber

Checking Equipmenc on the surface and below the water surface

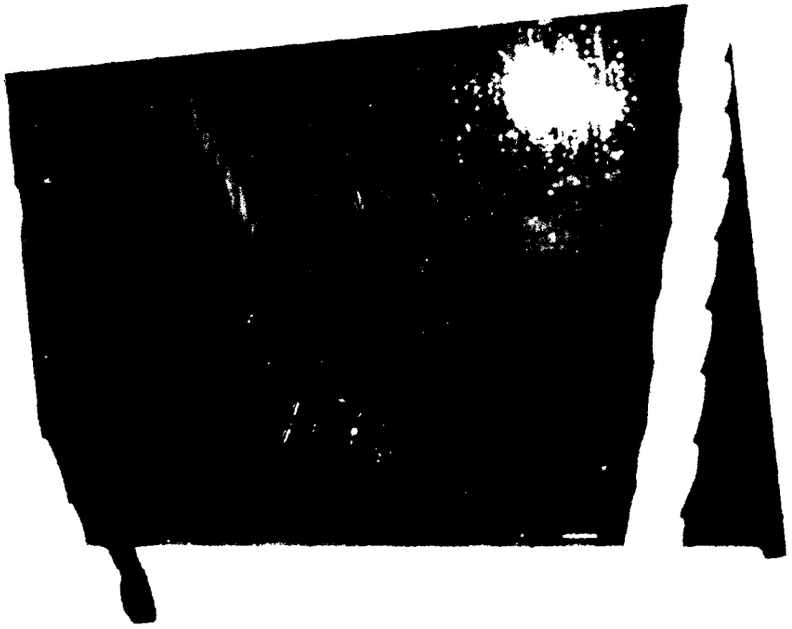
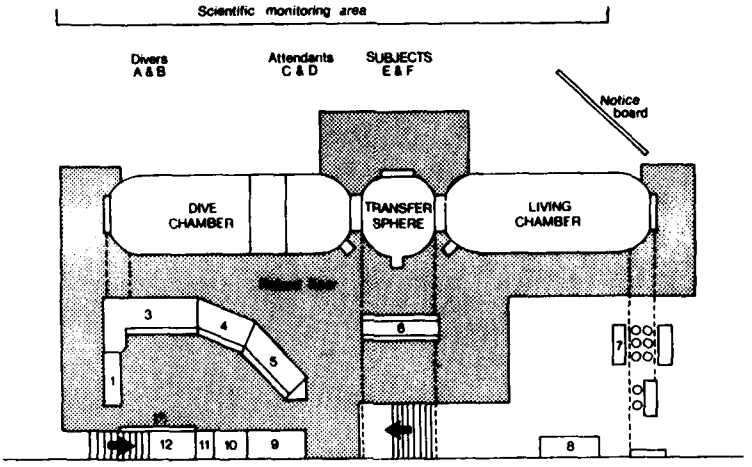


Figure 4. DDF Layout



This picture shows part of the Deep Diving Facility Layout

No. 1,3,4,5 - the Main Control Console

No. 6 - the Secondary or Emergency Control Console

No. 7 - the Environmental Loop Equipments

No. 8 - the Oxygen Room

No. 9,10,11,12 - the Main Engineering Room, the 'Pit' for potable water, fire suppression and Purifier.

The two dry subjects (E and F) in the Transfer Sphere remained at rest except for Doppler Monitoring. The two dry tenders (C and D) were carrying out moderate workloads.

The two wet divers (A and B) alternated on an underwater ergometer, with a workload of 50 Watts set. Wet suits and KMB-9 diving equipment were utilized.

DAILY ROUTINE - SUBJECTS

The following programme was based on the assumption that no decompression sickness or other diving ailments would occur either during or following the scheduled dives.

0800 - Pre-dive Physician's Assessment

0815 - Pre-dive Check - Diver's Equipment

0830 - Pre-dive Doppler reference monitoring (wet diving subjects to be monitored first)

0900 - Wet subjects dress

0915 - Pre-dive check-outs commence

0930 - Compression begins - (Doppler monitoring for dry subjects commences at depth)

1030 - (approx) - Divers surface
Doppler monitoring for wet subjects commences

1200 - Lunch in Divers' Lounge area
Doppler monitoring to continue

1530 - Doppler monitoring for all subjects ceases

1600 - Secure
Bends Watch activated.

The doppler monitoring team consisted of a visiting scientist from CERTSM Toulon, France, Mr. Masurel, and Dr. Kisman of DCIEM, Toronto. The equipment comprised DUGS aural equipment and was totally portable. Doppler monitoring commencing with the subjects reaching bottom continued for up to six hours after surfacing.

Figure 5. - Typical Bubble Activity Observed

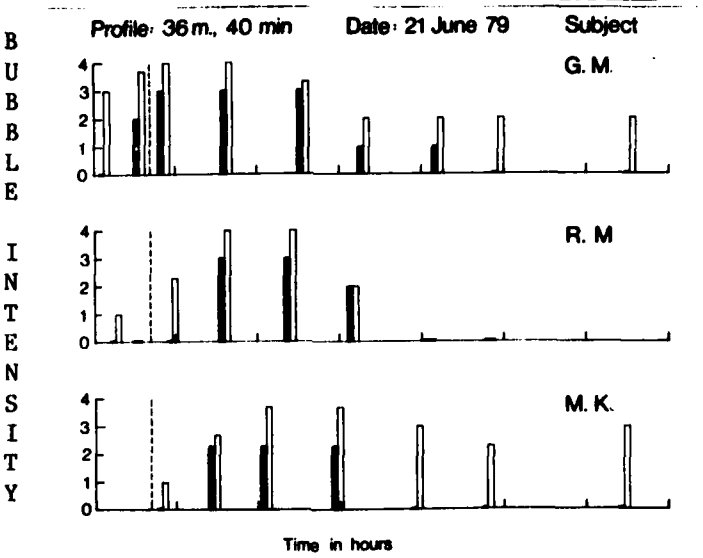


Figure 5. shows the type of doppler results obtained for each of the dives in the series. During decompression, bubble counts were observed at specific times indicative of internal decompression stress provoked by silent bubbles which on reaching certain levels of the KM or Spencer Codes were seen to culminate in cases of Type I bends.

Analysis is now in progress to quantify the number of bends with/vs profile and the usefulness of doppler techniques in correlation with the observed results, which will form a separate report.

The Y axis is based on the Kisman-Masurel scale([2]). On this scale, ultrasonic doppler monitoring measures the frequency, duration and amplitude of bubbles in the venous blood stream. The 0-4 is a code which defines the bubble intensity of a dive.

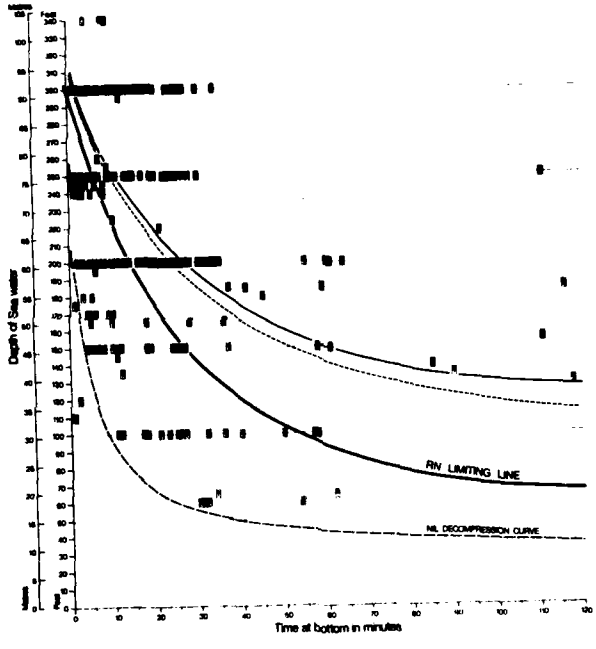
The X axis is purely a function of time.

The white bars depict bubble activity with exercise whereas the solid bars represent bubble activity without exercise.

Figure 6. Post-dive Doppler Monitoring

As a result of cases of unacceptable decompression sickness problems, caused in part by the high exercise level of the affected subjects, the entire schedule was revised to re-introduce the R.N. Limiting Line as shown in Table II of BR 2806.([8]) The resultant superimposed limits are shown in Figure 1. (revised)

Figure 1 (Revised) - XDC-2 Operational Envelope



The Kidd-Stubbs Model testing had historically involved quiescent non-working divers and, therefore, the effect of exercise on bubble formation is suspected of being the prime reason for the cases of decompression sickness recorded.

As a result of the above incidents, the dive schedule was radically altered (Table II):

Table II (revised)

DIVE SCHEDULE

DATE	DIVE DAY	SERIAL	
18 Jun - Mon	Preparation Day		
19 Jun - Tue	1	C	(36 msw for 50 min)
20 Jun - Wed	2		(cancelled)
21 Jun - Thu	3	B	(36 msw for 40 min)
22 Jun - Fri	4	B	(36 msw for 40 min)
25 Jun - Mon	5	A	(36 msw for 30 min)
26 Jun - Tue	6	A	(36 msw for 30 min)
27 Jun - Wed	7	D	(45 msw for 20 min)
28 Jun - Thu	8	F	(45 msw for 30 min)
29 Jun - Fri	9	E	(45 msw for 25 min)
3 Jul - Tue	10	E	(45 msw for 25 min)
4 Jul - Wed	11	F	(45 msw for 30 min)
5 Jul - Thu	12	C	(36 msw for 50 min on O_2 for decompression)
6 Jul - Fri	13	G	(54 msw for 15 min)
9 Jul - Mon	14	H	(54 msw for 20 min)
10 Jul - Tue	15	H	(54 msw for 20 min)
11 Jul - Wed	16	J	(54 msw for 25 min)
12 Jul - Thu	17	J	(54 msw for 25 min)
13 Jul - Fri	18	G	(54 msw for 15 min)

TABLE III (Revised)

DIVE TIMES FOR XDC-2 COMPUTERS

DIVE SERIAL	DEPTH (msw)	BOTTOM (1) TIME (min)	ASCENT(2) TIME TO 3 msw(min)	STOP TIME AT 3 msw (min)	TOTAL ASCENT TIME (min)	TOTAL TIME OF DIVE (min)
A	36	30	14	15	31	61
B	36	40	18	20	40	80
C	36	50	22	31	55	105
D	45	20	15	14	31	51
E	45	25	19	16	37	62
F	45	30	22	21	45	75
G	54	15	16	13	31	46
H	54	20	22	16	40	60
J	54	25	27	24	53	78

Descent time to bottom is included in bottom time. Descent rate varies from 18 msw/min to 8.8 msw/min at 54 msw for dive chamber and transfer sphere combination. Descent time to 36 msw is 2.5 min.; to 45 msw is 3.3 min.; to 54 msw is 4.2 min.

Ascent time is initially at 18 msw/min to 40 msw and is then determined by the maximum venting capability of the dive chamber/transfer sphere combination.

WEEKLY ANALYSIS

Week 1 Day 1 to Week 4 Day 18

This week commenced with a 50% incidence of bends when diving at 36m for 50 minutes. It quickly established that the estimated 3% bends incidence curve was too far right and doppler monitoring gave a very early indication that the dive was excessively stressful.

The following day was spent treating patients from the first dive and all subjects had a completely successful recovery.

Dive Day 3 - (Dive#2) - was established using the R.N. Limiting Line as laid down in BR 2806, Table Eleven and was for 36m (40 min). Doppler indicated a stressful dive.

Dive Day 4 - (Dive #3) - Once again doppler indicated a stressful dive (one type 1 incident occurred) but with a marked reduction in bubble activity. This indicated that the R.N. Limiting Line and the doppler grading were complementary.

Week 2

The next two days, Dive Days 5 and 6 (Dives #4 and #5), were used to establish a low doppler bubble activity level and this was achieved at 36m for 30 minutes. A clean series of dives were reported, however, one subject (a dry tender) "spiked" with bubble activity, had a sharp pain in his chest and then a full recovery.

By Dive Day 7 (Dive #6) the depth was increased to 45m with a bottom time of 20 minutes. This position was chosen as it was five minutes less than the R.N. Limiting Line and coincided with the RNPL Limiting Line.

This particular dive was clean, the bubble activity being mild in intensity.

The next day , Dive Day 8 (Dive#7), it was decided to increase the bottom time by 10 minutes, 5 minutes over the R.N. Limit Line; the bubble activity was moderate and one subject suffered a similar sensation to that experienced the previous Monday with a spike in doppler bubble activity coupled with a pain in his right shoulder.

This incident coupled with the one of a few days previous, and commensurate with past dives at DCIEM, pointed to "dry tenders" suffering decompression sickness. The only common denominator was that the attendants were working during the decompression phase and immediately after surfacing, albeit not arduously, but nonetheless, more so than the wet divers, or the other two dry subjects.

The following day, Dive Day 9 (Dive #8), the bottom time was reduced to 25 minutes in accordance with the R.N. Limit Line. On surfacing, the subjects remained in the DDF area at complete rest, except for doppler monitoring for 30 minutes and the tenders were instructed to slow down with their workloads.

Week 3

Dive Day 10 (Dive #9) which was 45m for 25 minutes, showed a drop in bubble activity and a clean dive was recorded.

Dive Day 11 (Dive #10) was a repeat of Dive Day 8 (Dive#7) and the same procedures were followed. However, one subject reported sick during that evening and was compressed to 18.3m and owing to symptoms (suspected Type II), was treated on an extended Table 6. A complete recovery was recorded. This particular subject who is 47 years of age and overweight, was a previous patient on Dive #1 and his previous 24-hour history revealed that he had had no sleep and a slight head cold. His past 24 hours disposition was not accurately recorded prior to the dive.

Dive Day 12 (Dive #11) was originally planned as a 36 msw for 20 minutes dive, but owing to the mildness experienced in the previous dive (deeper and same bottom time) it was argued that little meaningful data would be gleaned; therefore, a special dive was introduced. This entailed a repeat of Dive #1, 36 msw for 50 minutes; however, all subjects switched to O_2 at 10 msw during the decompression phase; the object of this dive was to determine the difference in doppler bubble activity using O_2 for future phases, and was not really a part of Phase I.

The interesting point of comparison is that there was no bubble activity; this was drastically different from Day 1 which showed a severe dive. The absence of bubble activity was a good indication that doppler readings could monitor and show the difference.

Dive Day 13 (Dive #12) returned to the original schedule once again. The depth was increased to 54 msw. The bottom time was 15 minutes and all subjects except for one showed little or no bubble activity. The one subject who did bubble subsequently suffered a mild form of decompression sickness and was treated on Table 5. This was an interesting case and there is no doubt that the subject had two strikes against him. In the first place, he was fatigued after a very stressful week, and secondly, he was moving far too much as a tender. These views are, of course, very subjective because the author was that subject.

Dive Day 14 (Dive #13) was an increase of 5 minutes bottom time over Dive Day 13 and passed without incident, although the doppler monitoring team assessed the dive as being of a stressful nature.

Dive day 15 (Dive #14) - This was a repeat of that of the previous day's dive of 54 msw for 20 mins., and a moderate to severe bubble activity was observed.

Dive Day 16 (Dive #15) - This was suspected to be of a stressful nature considering the previous results obtained at 20 mins. bottom time with this depth. The doppler indicated that this dive, which was 25 mins. at 54 msw, was graded moderate.

Dive day 17 (Dive #16) - This was a repeat of the dive of the previous day and the doppler readings indicated this as a severe dive. Although there were no confirmed cases of decompression sickness, post-dive grilling revealed that one or two subjects were suffering from "niggles" and one subject did have a transient pain.

Dive day 18 (Dive #17) - This was a repeat of a previous dive of 54 msw for 15 mins. This was graded as a mild dive.

TABLE IV - SUMMARY

DAY NO.	DEPTH	TIME AT BOTTOM	NO. OF DIVERS	DOPPLER SEVERITY	COMMENTS	TEAM
1	36m	50	6	Severe	50% bends incidence	B
2	Cancelled - Treatment of three Type I cases of decompression sickness from Day #1.					
3	36m	40	6	Moderate to Severe		B
4	36m	40	6	Moderate	1 Type I incident	A
5	36m	30	6	Moderate		B
6	36m	30	6	Mild to Moderate		A
7	45m	20	6	Mild		B
8	45m	30	6	Moderate	1 Type I	A
9	45m	25	6	Mild		B
10	45m	25	6	Mild		A
11	45m	30	6	Mild to Moderate	1 Type II incident	B
12	36m	50	6	Mild	O_2 from 10m	A
13	54m	15	6	Mild	1 Type I incident	B
14	54m	20	6	Mild to Moderate		A
15	54m	20	6	Moderate to Severe		B
16	54m	25	6	Moderate		A
17	54m	25	6	Severe		B
18	54m	15	6	Mild		A

NOTE:

Grading of a particular dive was based on the number of divers, out of the total number of divers participating in a particular dive, who, while at rest, experienced grade 3 bubbles on the KM scale. As an operational guideline, Kisman suggested the following grade be used:

0 - mild	Zero	Divers from six = mild
1 - mild/moderate	One	Diver from six = mild/moderate
2 - moderate	Two	Divers from six = moderate
3 - moderate/severe	Three	Divers from six = moderate/severe
4 - Severe	Four	Divers from six = severe
5 - Severe	Five	Divers from six = severe
6 - Severe	Six	Divers from six = severe

CONCLUSION

The initial results are very encouraging and should lead to a better understanding of the XDC-2 operation envelope. An interesting correlation between the R.N. Table Eleven Limiting Line as published in BR 2806 and our own results became apparent. Doppler correlation with incidence of bends was observed and the grading of dives would appear to present us with a safer approach to table validation in the future.

Subjects were suspected of not reporting "niggles", a trait of the diver, and Team "A" would appear to have built up an immunity to stressful dives, as their doppler bubble activity and bends incidence were less than those of "B" Team.

RECOMMENDATIONS

1. That a further series of dives be planned in order to obtain more information.

2. That Canada, in conjunction with U.K., U.S.A. and France, re-examine the doppler monitoring techniques as perfected by Kisman and Masurel.([3])

3. That air tables in the 36-54 msw range be examined for safer profiles thereby obviating the necessity of the dive supervisor's introducing his own safety factor while conducting operational dives within this range.

4. That the use of oxygen during decompression should be investigated in an effort to extend bottom times safely particularly at the deeper depths.

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Use of Decompression Computers in Diving.

6. CTF Operations Manual XDC-2 - Jun 78.

7. DCIEM Decompression Profiles, compiled by DCIEM Oct 77.

8. Royal Navy Diving Manual BR 2806.

ACKNOWLEDGMENT

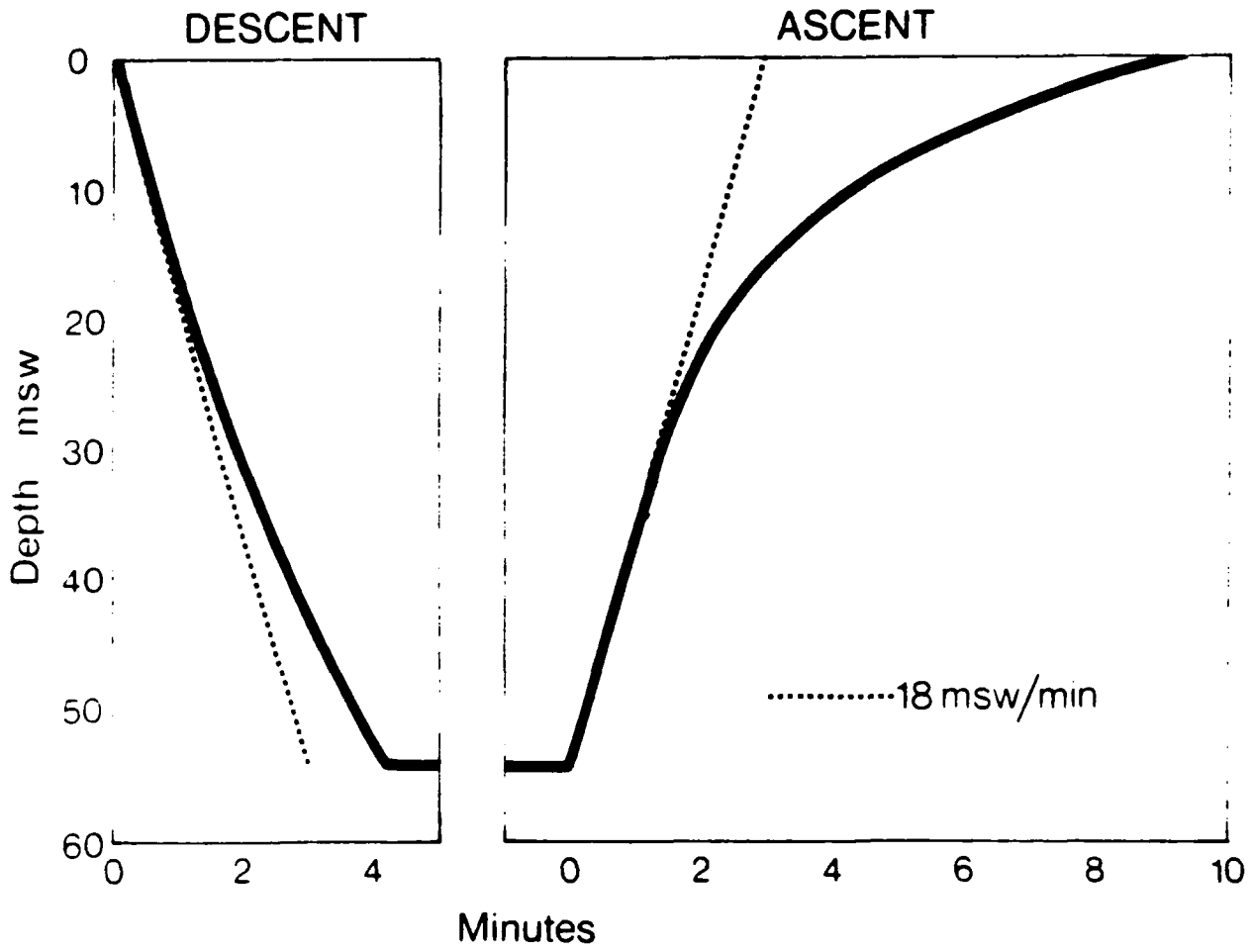
The author wishes to express his thanks to Mr. Nishi for his assistance in computing the dive profiles, Dr. Kisman for his permission to publish a typical doppler results graph, Dr. Kuehn for the reproduction of XDC-2 Predicted Envelopes and LCdr Ridgewell for his guidance during the operation.

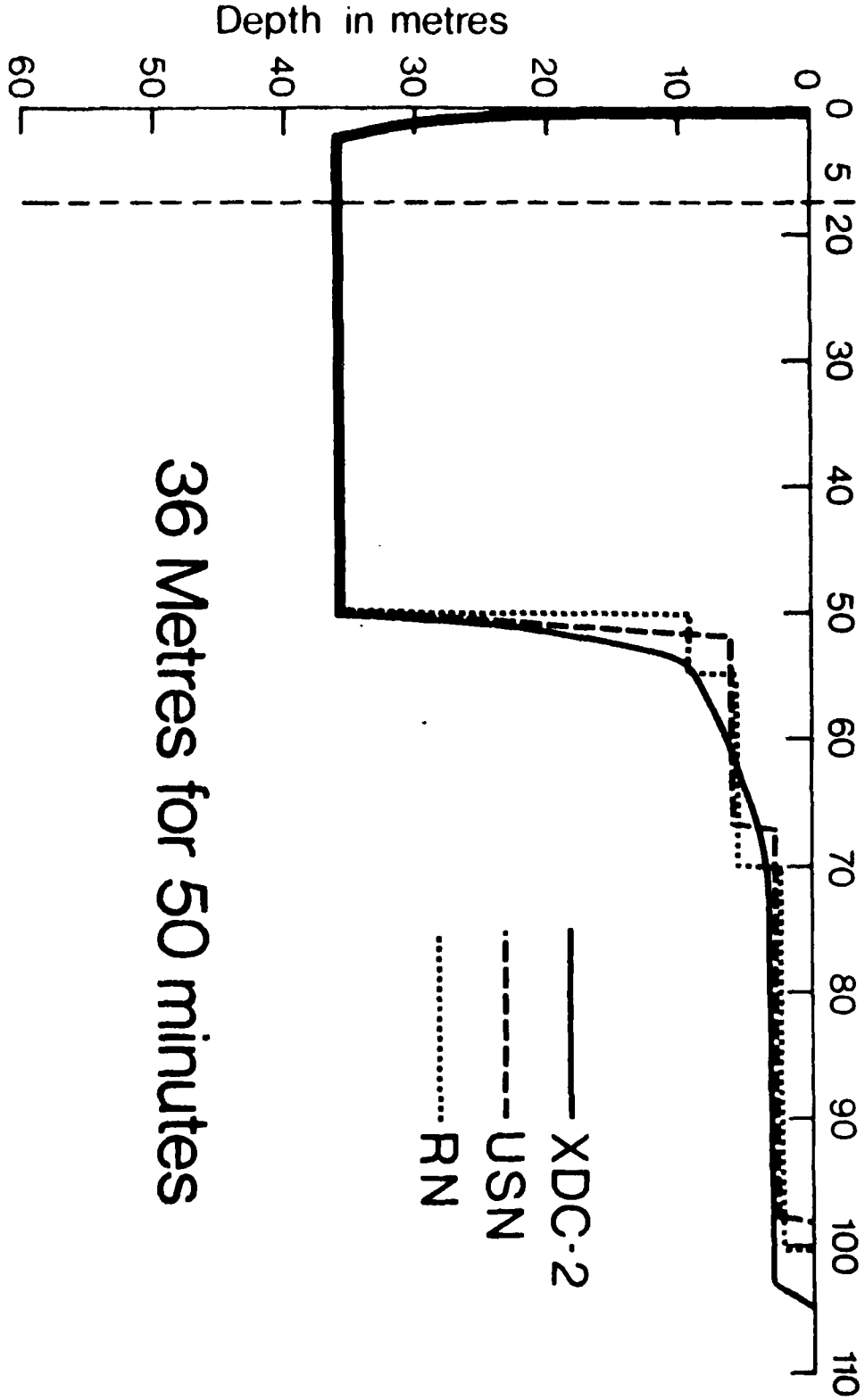
A special thank you should be extended to all the subjects who volunteered for this experiment and in particular, the Fleet Diving Unit (Pacific) on allowing members of their teams to help form the nucleus of the diving subjects.

LIST OF APPENDICES

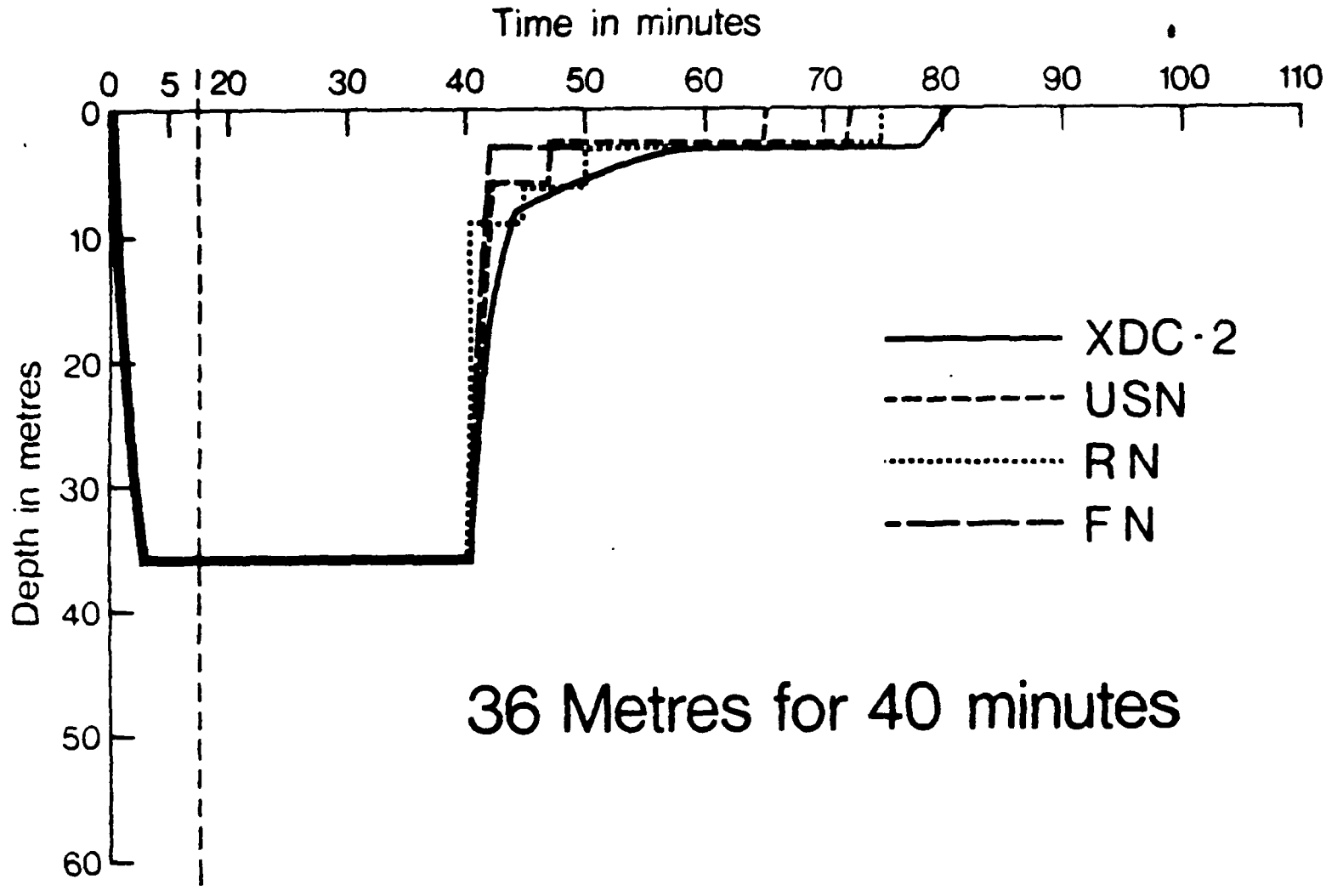
APPENDIX NUMBER	
1	DESCENT AND ASCENT PROFILES
2	36m FOR 50 min
3	36m FOR 40 min
4	36m FOR 30 min
5	45m FOR 20 min
6	45m FOR 25 min
7	45m FOR 30 min
8	54m FOR 25 min
9	54m FOR 20 min
10	54m FOR 15 min

Descent and Ascent profiles for Dive Chamber/ Transfer Sphere combination

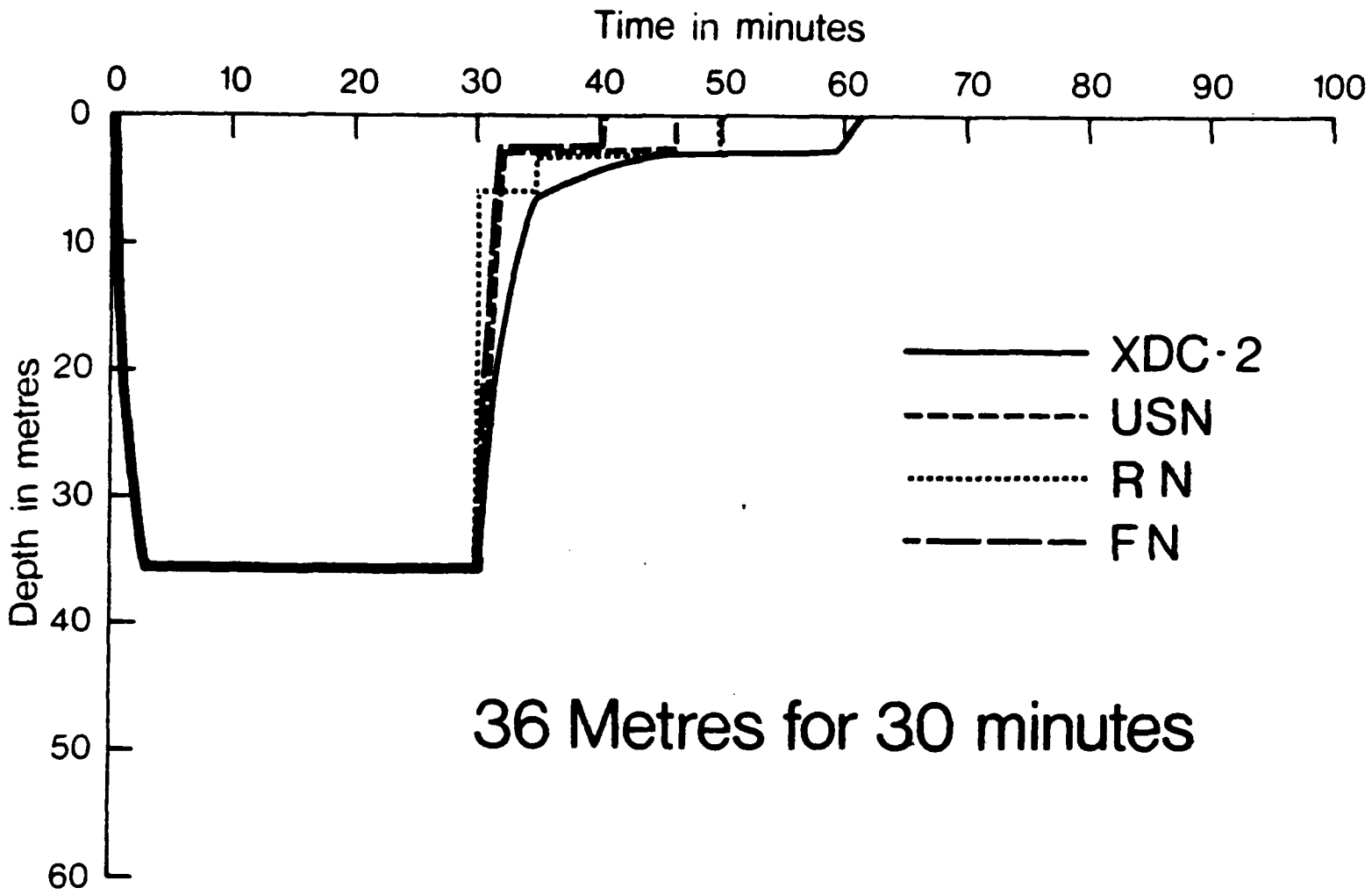




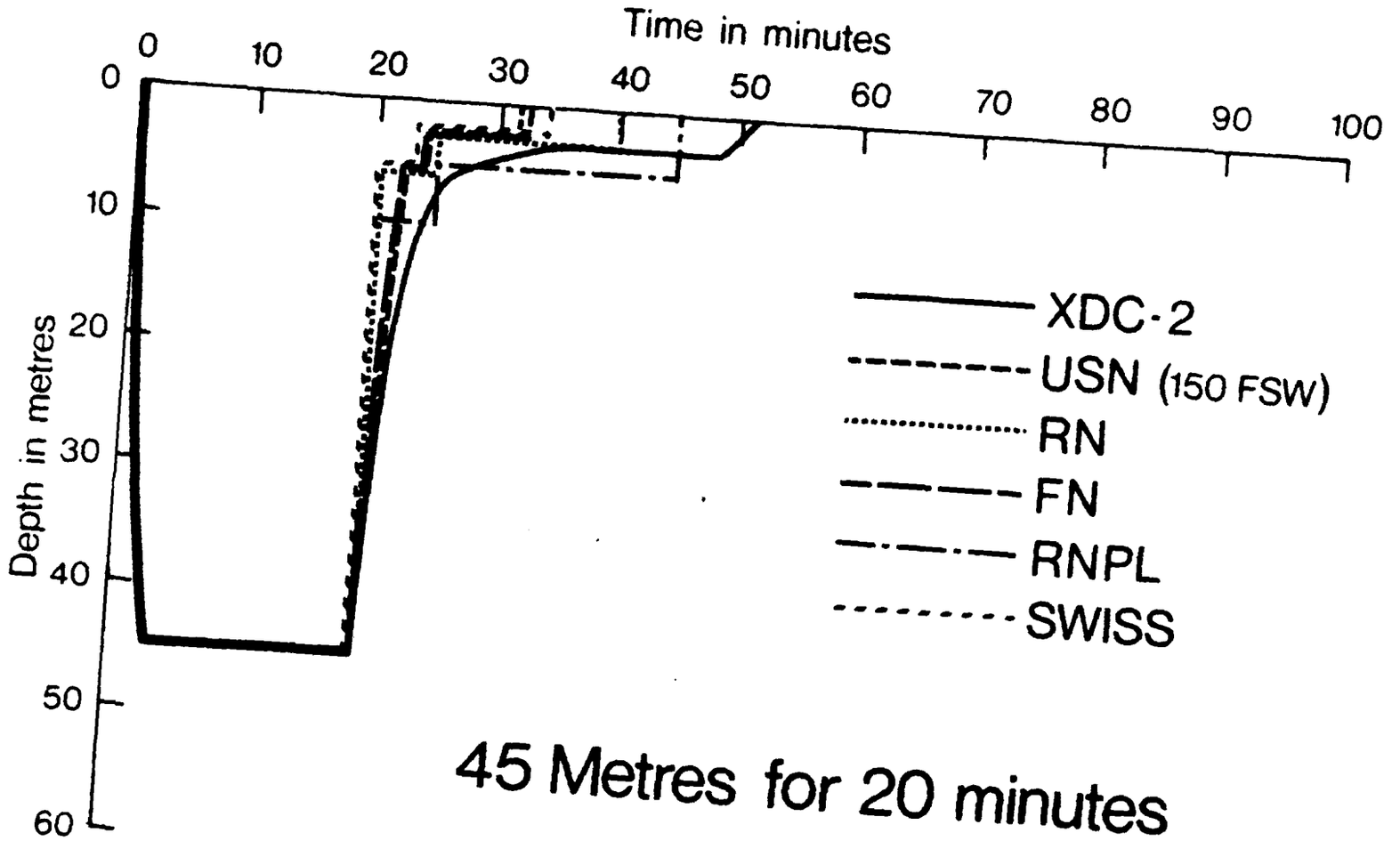
36 Metres for 50 minutes



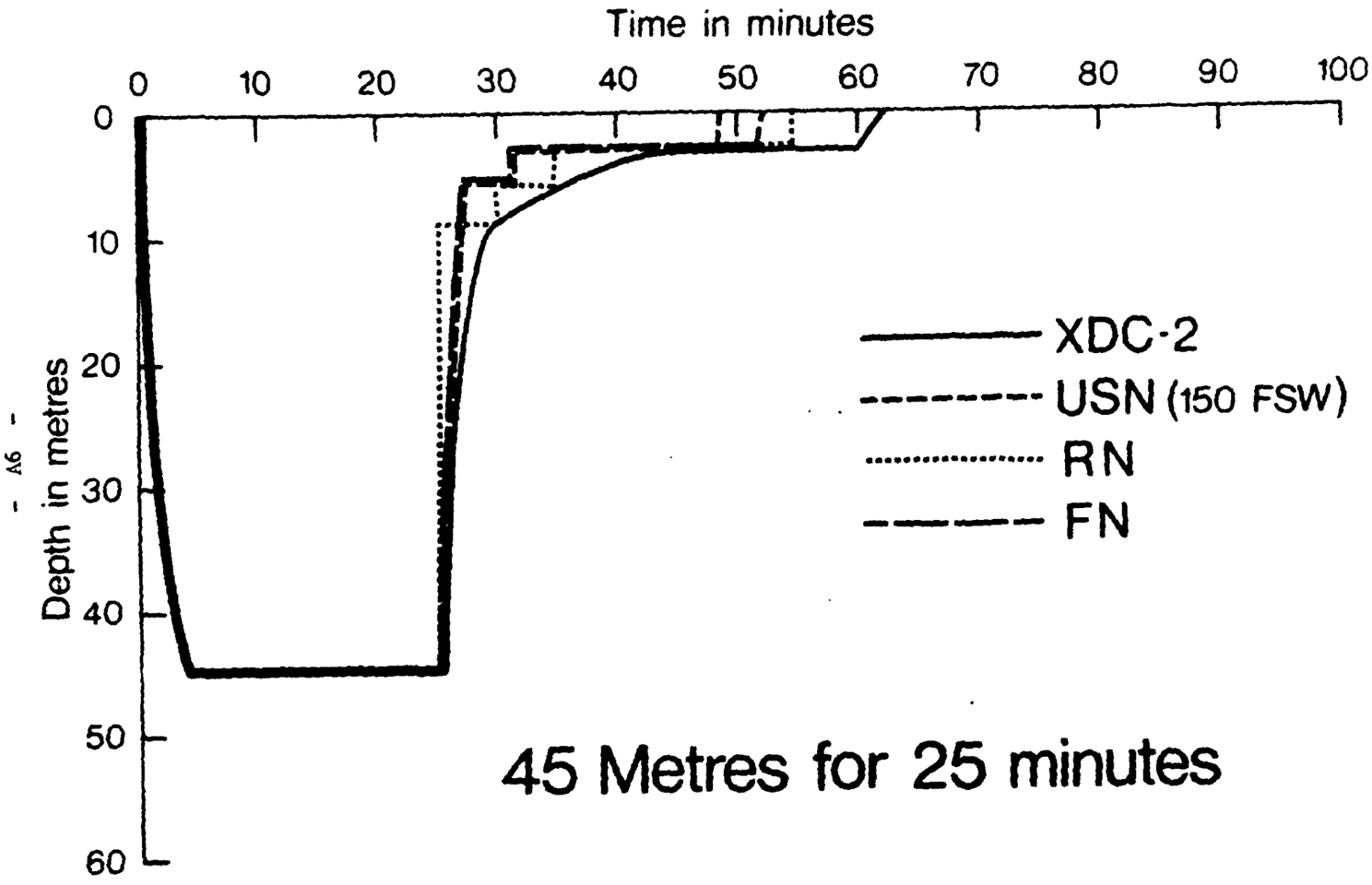
36 Metres for 40 minutes



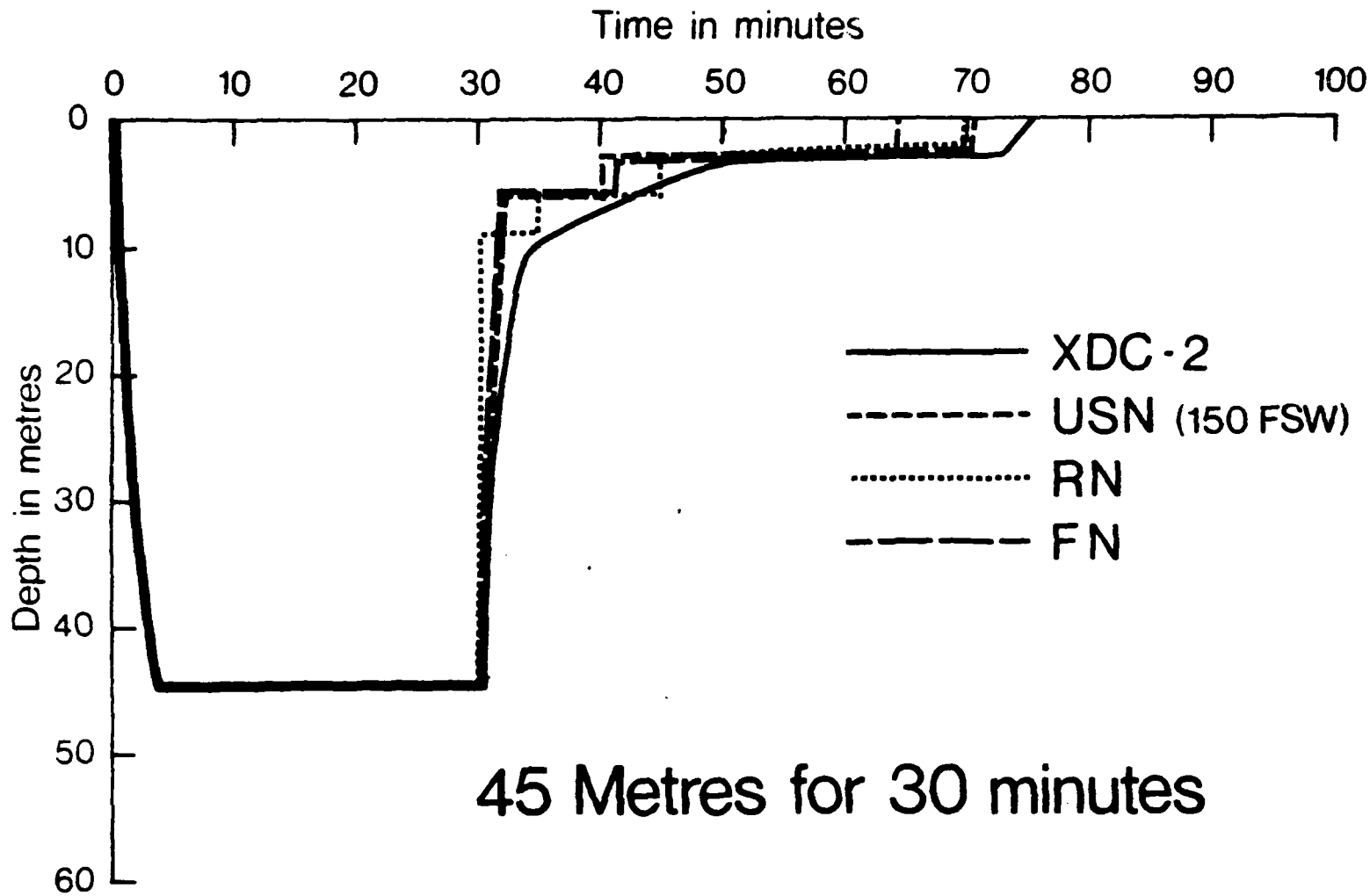
36 Metres for 30 minutes



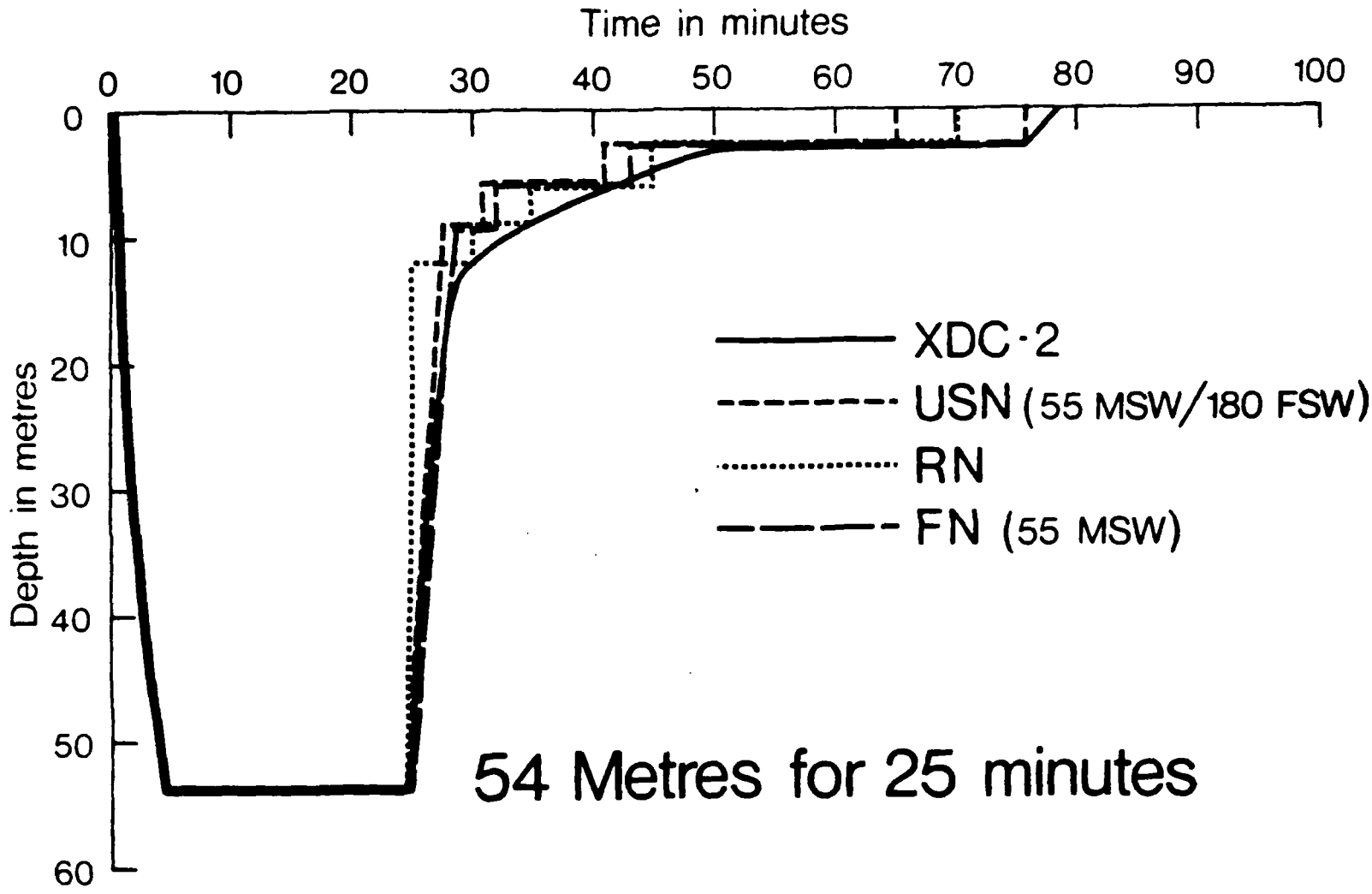
45 Metres for 20 minutes

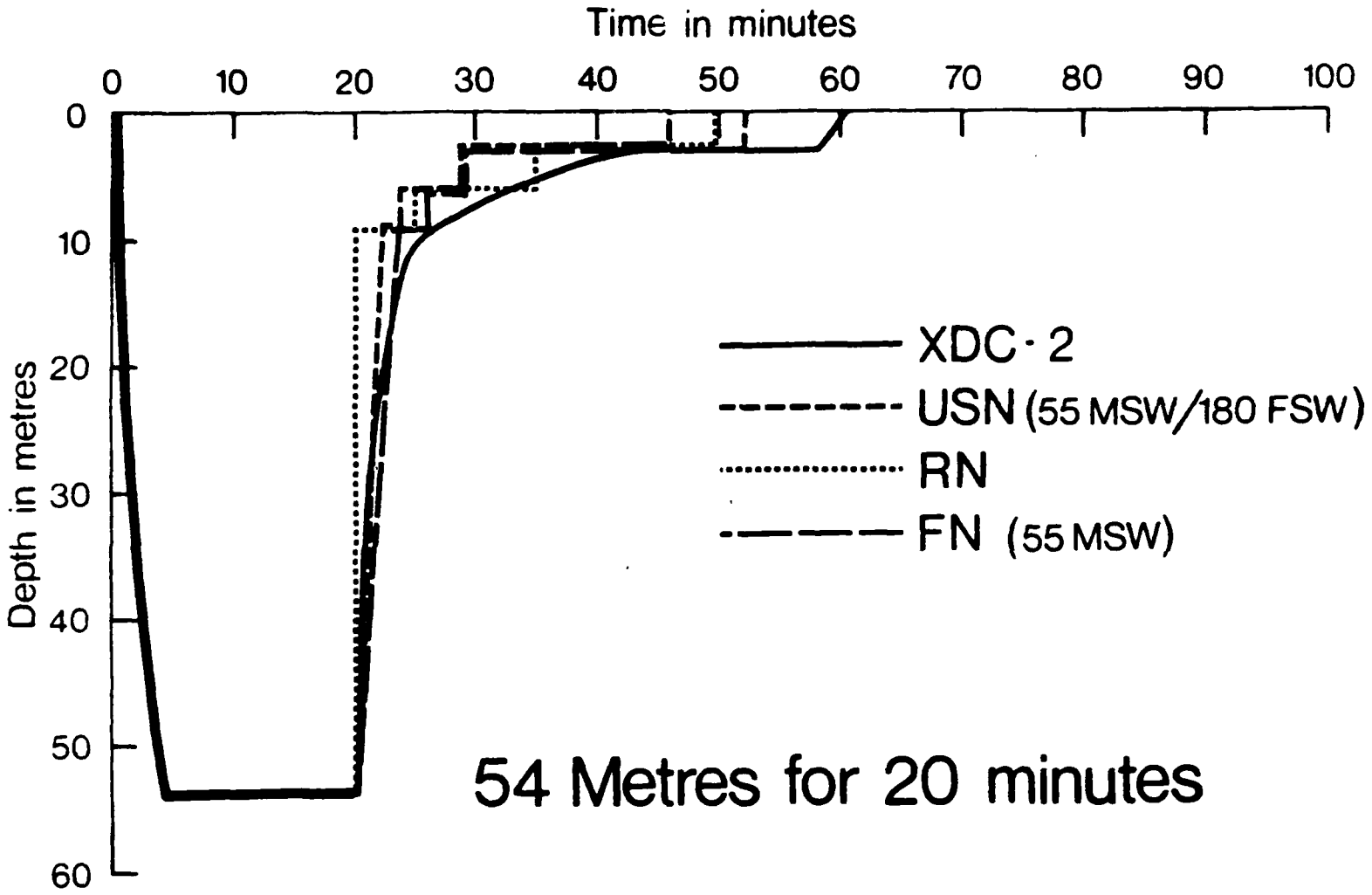


45 Metres for 25 minutes

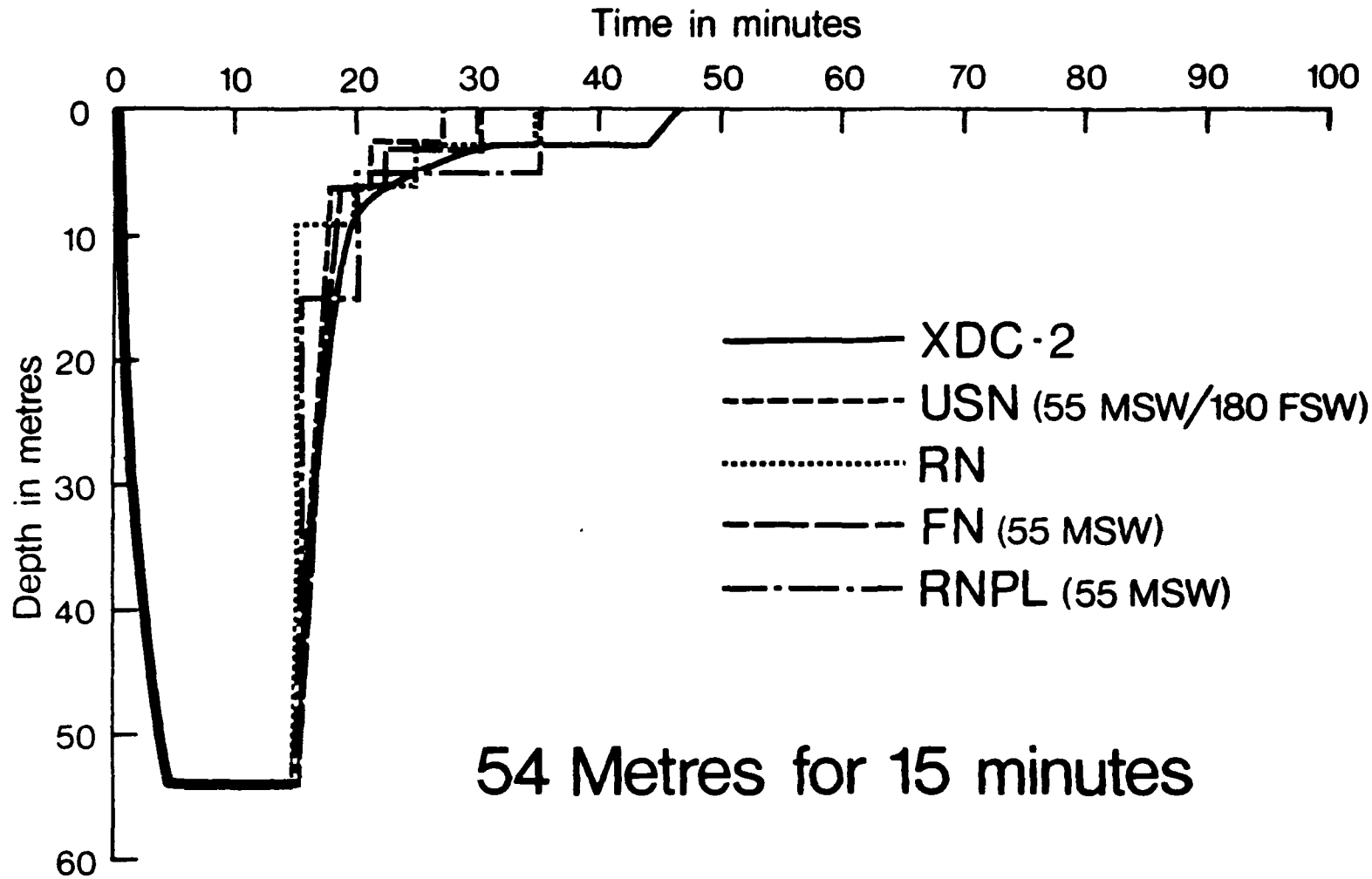


45 Metres for 30 minutes


Time in minutes
0
10
20
30
40
50
60
70
80
90
100
Depth in metres
0
10
20
30
40
50
60
XDC-2
USN (55 MSW/180 FSW)
RN
FN (55 MSW)
54 Metres for 25 minutes



54 Metres for 20 minutes



54 Metres for 15 minutes